Amendments to the Claims

The listing of claims will replace all prior versions, and listings of claims in the application.

1. (Currently Amended) A method for ~~modeling~~ enhancing the behavior of an optical fiber data channel the method comprising:

determining a sequence of data input to the optical fiber data channel;

using at least part of the sequence of data input to the data channel as an index to a channel model value;

sampling the data after it has passed through the channel to produce a sampled value;

comparing the channel model value with the sampled value; ~~and~~

adjusting the channel model value based on the results of the comparison between the channel model value and the sampled value;

identifying non-linearities in the optical fiber data channel based on the adjusted channel model; and

compensating for the non-linearities to enhance channel performance.

2. (Original) A method as in claim 1 wherein determining a sequence of data input to the data channel comprises determining the last N bits input to the channel.

3. (Original) A method as in claim 2, where N = 5.

4. (Original) A method as in claim 1 wherein the sampling of the data after it has passed through the channel to produce a sampled value comprises producing a real number representing the sampled value.

5. (Original) A method as in claim 1, wherein adjusting the channel model value further comprises adjusting the channel model value according to an LMS (Least Means Squared) algorithm.

6. (Original) A method as in claim 1 wherein adjusting the channel model value further comprises adjusting the channel model value until it converges.

7. (Previously Presented) A method as in claim 6 further comprising converting a look up table into Volterra Kernels.

8. (Original) A method as in claim 7 further comprising converting the look up table into Volterra Kernels using a Hadamard transform.

9. (Original) A method as in claim 7 further comprising adjusting the Volterra Kernels based on the results of the comparison between the channel model value and the sampled value.

10. (Previously Presented) A method as in claim 9 further comprising eliminating insignificant Volterra Kernels.

11. (Currently Amended) A method for ~~modeling~~ enhancing the behavior of an optical fiber data channel the method comprising:

determining a sequence of data input to the optical fiber data channel;

determining a Volterra Series representation of the channel;

accepting at least part of the sequence of data input to the data channel into the Volterra series representation of the channel to produce a channel model value;

sampling the data after it has passed through the channel to produce a sampled value;

comparing the channel model value with the sampled value; ~~and~~

adjusting the channel model value based on the results of the comparison between the channel model value with the sampled value;

identifying non-linearities in the optical fiber data channel based on the adjusted channel model; and

compensating for the non-linearities to enhance channel performance.

12. (Original) A method as in claim 11 wherein determining a Volterra Series representation of the channel comprises:

accepting a most recent value of the sequence of data input to the data channel; accepting the most recent value of the sequence of data input to the data channel into a first FIR (Finite Impulse Response) filter;

accepting a product of the most recent value of the sequence of data input to the data channel and a second most recent value of the sequence of data input to the data channel into a second FIR; and

summing an output of the first FIR and output of the second FIR to form the channel model value.

13. (Original) A method as in claim 11 wherein determining a Volterra Series representation of the channel comprises:

accepting a most recent value of the sequence of data input to the data channel; accepting the most recent value of the sequence of data input to the data channel into a first FIR filter;

accepting a product of the most recent value of the sequence of data input to the data channel and the second most recent value of the sequence of data input to the data channel into a second FIR;

accepting a product of the most recent value of the sequence of data input to the data channel and a third most recent value of the sequence of data input to the data channel into a third FIR; and

summing an output of the first FIR and output of the second FIR and output of the third FIR to form the channel model value.

14. (Original) A method as in claim 11 wherein determining a Volterra Series representation of the channel comprises:

accepting a most recent value of the sequence of data input to the data channel; accepting the most recent value of the sequence of data input to the data channel into a first FIR filter;

accepting a product of the most recent value of the sequence of data input to the data channel and the second most recent value of the sequence of data input to the data channel into a second FIR;

accepting a product of the most recent value of the sequence of data input to the data channel and a third most recent value of the sequence of data input to the data channel into a third FIR;

accepting a product, said product being the most recent value of the sequence of data

input to the data channel and the two next most recent data input, into a fourth FIR; and summing an output of the first FIR and output of the second FIR and output of the third

FIR and output of the fourth FIR to form the channel model value.

15. (Currently Amended) A method as in claim 11 wherein ~~the~~ a difference between the channel model value and the output of the channel is used to update all the FIRS.

16. (Original) A method as in claim 12 wherein the difference between the channel model value and the output of the channel is used to update all the FIRs.

17. (Original) A method as in claim 13 wherein the difference between the channel model value and the output of the channel is used to update all the FIRs.

18. (Original) A method as in claim 14 wherein the difference between the channel model value and the output of the channel is used to update all the FIRS.

19. (Original) A method as in 15 wherein an LMS algorithm is used to update all the FIRS.

20. (Original) A method as in 16 wherein an LMS algorithm is used to update all the FIRS.

21. (Original) A method as in 17 wherein an LMS algorithm is used to update all the FIRS.

22. (Original) A method as in 18 wherein an LMS algorithm is used to update all the FIRs.

23. (Previously Presented) A method for equalizing an optical signal, modulated with a digital signal, received over an optical channel, the method comprising: converting the optical signal into an electrical signal;

summing the electrical signal with a correction signal;

providing the summed signal to a detector;

detecting the summed signal to produce decisions;

providing the decisions to a nonlinear channel estimator;

estimating the correction signal in the nonlinear channel estimator; and

adapting the estimating in the nonlinear channel estimator in accordance with the decisions.

24. (Previously Presented) The method of claim 23 wherein estimating the correction signal in the nonlinear estimator further comprises:

accepting the decisions;

predicting the inter-symbol interference of the channel in a nonlinear channel estimator; and

forming a correction signal from the predicted inter-symbol interference.

25. (Previously Presented) The method of claim 24 wherein predicting the inter-symbol interference of the channel further comprises:

providing the decisions to a plurality of Volterra Kernels; and

summing the output of the plurality of Volterra Kernels to form a correction signal.

26. (Original) The method of claim 25 further comprising:

comparing the predicted inter-symbol interference to inter-symbol interference in the electrical signal; and

updating the Volterra Kernels based on the result.

27. (Original) The method as in claim 26 wherein updating the Volterra Kernels comprises using a LMS (Least Means Squared) algorithm to update the Volterra Kernels.

28. (Original) The method of claim 24 wherein predicting the inter-symbol interference of the optical channel further comprises:

providing the data decisions as an address into a look up table;

outputting a value stored in the look up table as the predicted inter-symbol interference; comparing the predicted inter-symbol interference to the inter-symbol interference in the electrical signal; and

updating the value stored in the look up table based on the result.

29. (Original) The method as in claim 28 wherein updating the value stored in the look up table comprises using a LMS (Least Means Squared) algorithm.

30. (Previously Presented) An apparatus for equalizing a signal received over an optical channel, the apparatus comprising:

an input that accepts an optical signal;

a converter that converts the optical signal into an electrical signal;

a summation unit that sums the electrical signal with a correction signal;

a detector that detects the summed signal to produce decisions; and

a nonlinear channel estimator that estimates the correction signal and adapts the estimating in accordance with the decisions.

31. (Original) The apparatus of claim 30 wherein the nonlinear estimator further comprises:

an input that accepts the decisions;

an estimating circuit that predicts the inter-symbol interference of the channel; and

an output that provides a correction signal from the estimated inter-symbol interference.

32. (Original) The apparatus of claim 31 wherein estimating circuit that estimates the intersymbol interference of the channel further comprises:

a plurality of Volterra kernels that accept the decisions and produce individual outputs; and

a summation unit that sums the individual outputs of the plurality of Volterra Kernels to form a correction signal.

33 (Original) The apparatus of claim 32 further comprising:

a comparator for comparing the predicted inter-symbol interference to the inter-symbol interference in the electrical signal; and

means for updating the Volterra kernels based on the result.

34. (Original) The apparatus as in claim 33 wherein the comparator that compares the predicted inter-symbol interference to the inter-symbol interference in the electrical

signal includes a LMS (Least Means Squared) algorithm that compares the predicted inter-symbol interference to the inter-symbol interference in the electrical signal.

35. (Previously Presented) The apparatus of claim 31 wherein the estimating circuit that estimates the intersymbol interference further comprises:

a look up table which accepts the data decisions as an address into the look up table; values of the predicted inter-symbol interference stored in the look up table;

a subtractor that subtracts the predicted inter-symbol interference from the electrical

signal to produce a signal substantially free from intersymbol interference;

a second subtractor that subtracts the decision from the substantially inter-symbol interference free signal to produce an error; and

means for updating at least one of the values stored in the look up table based on the error.

36. (Original) The apparatus as in claim 35 wherein comparing the comparator that compares the estimated inter-symbol interference to the inter-symbol interference in the electrical signal comprises a LMS (Least Means Squared) algorithm that compares the predicted inter-symbol interference to the inter-symbol interference in the electrical signal.

37. (Previously Presented) A method for decoding a signal received over an optical channel, the method comprising:

receiving a signal including linear and nonlinear components;

estimating, in a nonlinear channel estimator having a memory width, expected values of the received signal;

computing branch metrics over a number of states based on the expected values of the received signal, wherein the number of states corresponds to the memory width;

providing the computed branch metrics to a Viterbi decoder; and

Viterbi decoding the received signal using the branch metrics provided to the Viterbi decoder.

38. (Previously Presented) The method of claim 37 wherein estimating, in a nonlinear channel estimator, the expected values of the received signal comprises:

providing a value of the received signal to a Volterra kernel estimator; and

computing the expected value sent based on the output of the Volterra kernel estimator.

39. (Previously Presented) The method of claim 37 wherein estimating, in a nonlinear channel estimator, the expected values of the received signal comprises: providing the value of the received signal as an address to a look up table; and looking up a stored value as an actual value transmitted.

40. (Previously Presented) An apparatus for decoding a signal received over an optical channel, the apparatus comprising:

a receiver for receiving a signal including linear and nonlinear components;

a nonlinear channel estimator, having a memory width, that computes expected values of the received signal;

a branch metrics computer for computing branch metrics over a number of states based on the expected values of the received signal, wherein the number of states corresponds to the memory width;

a Viterbi decoder that accepts the computed branch metrics and Viterbi decodes the received signal.

41. (Previously Presented) The apparatus of claim 40 wherein the nonlinear channel estimator that computes the expected values of the received signal comprises a Volterra kernel estimator that computes the expected values sent based on an output of the Volterra kernel estimator.

42. (Previously Presented) The apparatus of claim 40 wherein the nonlinear channel estimator that computes the expected values of the received signal comprises a look up table that uses a value of the received signal as an address to look up a stored value as an actual value transmitted.

43. (Original) A method for detecting digital data modulated on an optical signal and received over an optical channel, the method comprising:

converting the optical signal to an electrical signal;

converting the electrical signal to a multibit digital representation; estimating distortion introduced in the optical signal by the optical channel; compensating the multibit digital representation for the distortion; and detecting the digital data from the compensated multibit digital representation.

44. (Original) A method as in claim 43 wherein estimating distortion introduced in the optical signal by the optical channel comprises estimating in a Volterra Kernel estimator the distortion introduced in the optical channel.

45. (Original) A method as in claim 43 wherein estimating distortion introduced in the optical signal by the optical channel comprises estimating in a lookup table estimator the distortion introduced in the optical channel.

46. (Original) An apparatus for detecting digital data modulated on an optical signal and received over an optical channel, the apparatus comprising:

a converter for converting the optical signal to an electrical signal;

an analog to digital converter that converts the electrical signal to a multibit digital representation;

an estimator that estimates distortion introduced in the optical signal by the optical channel;

a compensator that compensates the multibit digital representation for the distortion; and a detector that detects the digital data from the compensated multibit digital representation.

Claims 47 and 48. (Cancelled).

49. (Original) An apparatus as in claim 46 wherein the estimator that estimates distortion introduced in the optical signal comprises a Volterra Kernel estimator.

50. (Previously Presented) An apparatus as in claim 46 wherein the estimator that estimates distortion introduced in the optical signal comprises a lookup table estimator.

51. (Previously Presented) A method as in claim 1 comprising configuring the channel model in accordance with a training sequence.